

In re: Park et al.
Serial No.: 10/615,362
Filed: July 8, 2003
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REMARKS

Applicants appreciate the Examiner's thorough examination of the present application as evidenced by the Final Office Action of October 28, 2004 (hereinafter "Final Action"). In response, Applicants respectfully request that the Examiner take one final look at independent Claims 14 and 23 in light of the remarks presented herein. Applicants respectfully submit that the cited references do not disclose, teach, or suggest all of the recitations of independent Claims 14 and 23. Accordingly, Applicants submit that all pending claims are in condition for allowance. Favorable reconsideration of all pending claims is respectfully requested for at least the reasons discussed hereafter.

Claims 23 - 26 Satisfy the Requirements of 35 U.S.C. §112, ¶1

Claims 23 - 26 stand rejected under 35 U.S.C. §112, ¶1 as failing to comply with the written description requirement because the description of a "unitary" plug is not disclosed in the specification. Applicants respectfully disagree. Applicants have used the term "unitary" in Claim 23 in accordance with its dictionary meaning: having the character of a unit: undivided, whole. This is illustrated, for example, in FIG. 6 where a unitary contact plug 215 is shown that fills the contact hole on the cobalt layer 211. The unitary contact plug 215 is undivided or whole in accordance with the dictionary meaning of unitary. Accordingly, Applicants respectfully submit that Claims 23 - 26 satisfies the requirements of 35 U.S.C. §112.

Independent Claim 14 is Patentable

Independent Claim 14 stands rejected under 35 U.S.C. §102(b) as being anticipated by U. S. Patent No. 5,998,873 to Blair et al. (hereinafter "Blair"). Independent Claim 14 also stands rejected under 35 U.S.C. §102(b) as being anticipated by U. S. Patent No. 6,271,122 to Wieczorek et al. (hereinafter "Wieczorek").

Independent Claim 14 is directed to a method of forming a metal contact in a semiconductor device and recites, in part:

forming an insulating layer having a contact hole therein on a silicon substrate;
forming a cobalt layer directly on a bottom and inner walls of the contact hole;
forming a cobalt silicide layer at the bottom of the contact hole **while** forming a titanium nitride layer on the cobalt layer;
...(Emphasis added)

Applicants respectfully submit that neither Blair nor Wieczorek disclose or suggest at least the highlighted recitations of Claim 14 above.

Turning first to Blair, as explained at column 5, lines 57 through 62, the metal silicide interface layers 328 are formed by reacting the metal adhesion layer 324 with silicon. In sharp contrast with the recitations of Claim 14, the titanium nitride layer 326 is formed **before** the metal silicide interface layers 328 are formed (Blair, col. 5, lines 50 - 56) rather than while the metal silicide interface layers 328 are formed.

Turning next to Wieczorek, the barrier layer 115 of FIG. 2C comprises both a cobalt layer and a titanium layer as explained at column 5, lines 26 - 30. Thus, the titanium nitride layer is not formed while the cobalt silicide layer is formed because the titanium layer comprising the titanium nitride layer had already been formed when the barrier layer 115 was formed.

For at least the foregoing reasons, Applicants respectfully submit that independent Claim 14 is patentable over Givens and that dependent Claims 15 - 22 are patentable at least by virtue of their depending from an allowable claim.

Independent Claim 23 is Patentable

Independent Claim 23 stands rejected under 35 U.S.C. §102(b) as being anticipated by Blair, Wieczorek and U. S. Patent No. 5,700,722 to Sumi. Independent Claim 23 is directed to a method of forming a metal contact in a semiconductor device and recites, in part:

...
forming a cobalt silicide layer at the bottom of the contact hole **while** forming a unitary plug that fills the contact hole on the cobalt layer.
(Emphasis added).

This aspect of the present invention is illustrated, for example, in FIG. 6 where a unitary contact plug 215 is shown that fills the contact hole on the cobalt layer 211. Applicants respectfully submit that neither Blair nor Wieczorek nor Sumi disclose or suggest at least the highlighted recitations of Claim 23 above.

For the same reasons discussed above with respect to Claim 14, neither Blair nor Wieczorek disclose or suggest forming the cobalt silicide layer while forming a unitary plug that fills the contact hole. With respect to Blair, the conductive plug layer 330 is formed after the metal silicide interface layers 328 are formed. (Blair, col. 6, lines 254 - 28). With respect to Wieczorek, the plug 117 is formed after the cobalt silicide layer 109 is formed. (Wieczorek, col. 5, lines 48 - 50).

Turning next to Sumi, this reference does not disclose forming the cobalt silicide layer at the bottom of the contact hole while forming a unitary plug that fills the contact hole. Specifically, the contact hole is filled with silicon 30 as shown in FIG. 1(B) of Sumi. Then, a cobalt layer 32 is formed on the silicon plug 30 (Sumi, FIG. 1C). The cobalt silicide layer 34 is formed by heating the resulting structure (Sumi, col. 6, lines 36 - 41). In sharp contrast with the recitations of Claim 23, however, the contact hole is already filled according when the cobalt silicide layer 34 is formed according to Sumi's teachings.

For at least the foregoing reasons, Applicants respectfully submit that independent Claim 23 is patentable over Givens and that dependent Claims 24 - 26 are patentable at least by virtue of their depending from an allowable claim.



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CONCLUSION

In light of the above amendments and remarks, Applicants respectfully submit that the above-entitled application is now in condition for allowance. Favorable reconsideration of this application, as amended, is respectfully requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (919) 854-1400.

Respectfully submitted,

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